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ORIGINAL ARTICLE

Pancreatic resection without routine intraperitoneal drainage

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Abstract

Background: Most surgeons routinely place intraperitoneal drains at the time of pancreatic resection but this practice has recently been challenged.

Objective: Evaluate the outcome when pancreatic resection is performed without operatively placed intraperitoneal drains.

Methods: In all, 226 consecutive patients underwent pancreatic resection. In 179 patients drains were routinely placed at the time of surgery and in 47 no drains were placed. Outcomes for these two cohorts were recorded in a prospective database and compared using the χ^2- /Fisher's exact test for categorical variables, and Wilcoxon's test for continuous variables.

Results: Demographic, surgical and pathological details were similar between the two cohorts. Elimination of routine intraperitoneal drainage did not increase the frequency or severity of serious complications. However, when all grades of complications were considered, the number of patients that experienced any complication (65% vs. 47%, $P = 0.020$) and the median complication severity grade (1 vs. 0, $P = 0.027$) were increased in the group that had drains placed at the time of surgery. Eliminating intra-operative drains was associated with decreased delayed gastric emptying (24% vs. 9%, $P = 0.020$) and a trend towards decreased wound infection (12% vs. 2%, $P = 0.054$). The readmission rate (9% vs. 17% $P = 0.007$) and number of patients requiring post-operative percutaneous drains (2% vs. 11%, $P = 0.001$) was higher in patients who did not have operatively placed drains but there was no difference in the re-operation rate (4% vs. 0%, $P = 0.210$).

Conclusion: Abandoning the practice of routine intraperitoneal drainage after pancreatic resection may not increase the incidence or severity of severe post-operative complications.

Keywords
outcomes, pancreatic neoplasia

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Introduction

For decades, routine placement of intraperitoneal drains after pancreatic resection and anastomosis has been considered mandatory. Although the use of drains has proven to be unnecessary or even deleterious in other operations such as a splenectomy, gastrectomy and colorectal resection, many surgeons fear that abandoning routine intraperitoneal drainage after a pancreaticoduodenectomy would not be safe. The purpose of these drains is to evacuate blood, bile, pancreatic juice or chyle, that may accumulate after surgery and to serve as an early warning sign of anastomotic leak and associated haemorrhage. Although failure of the enteric or biliary anastomosis is relatively uncommon after a pancreaticoduodenectomy, a post-operative pancreatic fistula remains a significant problem in about 10% of patients.[1,2] A pancreatic fistula is thought to contribute to the most morbid complications of the operation particularly when combined with biliary leakage which activates pancreatic enzymes and can lead to erosion of retroperitoneal vessels and haemorrhage, intra-abdominal abscess, sepsis, multi-system organ failure and death.

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The majority of patients do not develop a post-operative pancreatic fistula and experience with drains in other operations suggests that unnecessary drains may cause complications. Drains can serve as a portal of entry for bacteria and change a benign post-operative fluid collection into an abscess. Drains can cause trauma from suction and can certainly erode into anastomoses and cause leaks.

Some surgeons have abandoned the routine use of drains whereas others have taken a compromise position by removing drains early in the post-operative period based on drain volume and amylase content.[3,4] However, the early dynamic post-operative changes in drain volume and amylase concentration are not clearly correlated with the later development of a clinically significant post-operative pancreatic fistula making this approach problematic.[5,6]

In recent years, the ability to place drains post-operatively using ultrasound or computed tomography has provided some measure of increased safety for pancreas resection without the use of routine intraperitoneal drainage. If patients develop signs or symptoms of a clinically significant post-operative pancreatic fistula or another fluid collection, a drain can almost always be safely placed and a return to the operating room is often unnecessary.[7]

Methods

In all, 226 consecutive patients underwent a pancreatic resection by a single surgeon (W.E.F.). From 2004 to 2009 (Cohort 1, n = 179), drains were routinely placed at the time of surgery. For the Whipple procedure, two closed-suction drains were placed near the biliary and pancreatic anastomoses. For distal pancreatectomies, one closed-suction drain was placed near the pancreatic transection margin. Drains were removed when output decreased to <20 ml/day and amylase concentration was <360 IU/ml (3× the upper limit of the normal serum value). In 2009, a decision was made to perform a pancreatic resection without routine intraperitoneal drainage for all patients requiring resection. In the second cohort of consecutive patients (2009 to 2010, n = 47) no drains were placed at the time of surgery. No patients were excluded from the study.

Demographic information was obtained from the medical records. A stated past medical history of or presence in the medical record of a history of hypertension, chronic obstructive pulmonary disease, diabetes, coronary artery disease, chronic pancreatitis or renal insufficiency was recorded. Obesity was defined as a body mass index (BMI) greater than or equal to 30 kg/m^2. Tobacco use was recorded as never, ever or current smoker. The American Society of Anesthesiologists (ASA) score was obtained from the anaesthesia record. Operative time was also obtained from the anaesthesia record and defined as the time from incision to application of the final wound dressing. Estimated intra-operative blood loss (EBL) was obtained from the anaesthesia record, not from the surgeon's operative report. The surgeon graded the pancreatic texture as soft/normal or hard in the operative note. The surgeon measured the pancreatic duct with a probe and recorded the size of the duct in the operative note (≤3 mm was considered normal). All specimens were submitted to pathological analysis, and the diagnosis and staging was recorded.

Operative mortality was defined as any death within 30 days of surgery. All complications within 30 days of the date of surgery were recorded using specific and standardized definitions. Complications were defined and graded in severity using the Common Terminology Criteria for Adverse Events CTCAE (v4.0) (Grade 1–5) unless otherwise stated below. For grading schemes with A, B, C rather than 1–5, severity scores were converted to 1–3 to calculate median complication severity scores.

Anastomotic failure

A pancreatic fistula was defined and graded using the three-tiered definition proposed by the International Study Group on Pancreatic Fistula (ISGPF).[8] For patients with drains, the maximum drain amylase concentration (highest concentration in any drain) was recorded and used for the analysis. Biliary leak was defined as drainage of any volume of fluid clinically consistent with bile (or with a bilirubin concentration greater than the serum value) from operatively or percutaneously placed drains or the wound.

Percutaneous abdominal drainage

Fluid drained from the abdomen with a positive Gram stain or culture was considered an intra-abdominal abscess. Fluid drained from the abdomen with an amylase concentration >360 IU/ml was considered a pancreatic fistula. Two complications were logged if the fluid met both the criteria for an abscess and fistula. The need for percutaneous abdominal drainage (placement of an intra-abdominal drain using any image-guided technique such as CT or ultrasound) or even reoperation was not counted as a separate additional complication but was used to grade the severity of the complication that was the indication for the procedure (pancreatic fistula, abdominal abscess, etc.).

Delayed gastric emptying (DGE)

Delayed gastric emptying was defined and graded using the schema proposed by the International Study Group of Pancreatic Surgery (ISGPS).[9] Grade A delayed gastric emptying (DGE) was considered present in patients who required a nasogastric tube (NGT) between postoperative day (POD) 4 and 7 (including reinsertion for nausea or vomiting after initial removal), or those who failed to tolerate a solid diet by POD 7, but did tolerate a solid diet before POD 14. Grade B DGE was considered present in patients who required an NGT from POD 8–14 (including reinsertion for nausea or vomiting after initial removal) or in patients who could not tolerate a solid oral intake by POD 14, but were able to resume a solid oral diet before POD 21. Grade C DGE was considered present in patients who required an NGT after POD 14 (including reinsertion for nausea or vomiting after initial removal), or in patients who were not able to maintain a solid oral intake by POD 21.[10]

Infectious complications and organ failure

Fever was defined as any recorded temperature greater than or equal to 100.4°F (38.0°C). Wound infection was defined as spontaneous or surgical drainage from the wound with a positive Gram stain or culture. As stated above, an intra-abdominal abscess was defined as fluid drained from the abdomen with a positive Gram stain or culture. Pneumonia was defined as a positive sputum culture associated with an infiltrate on radiological imaging requiring treatment with antibiotics. *Clostridium dificile* colitis was defined as diarrhoea associated with a positive stool culture for the organism. A urinary tract infection (UTI) was defined as a urine culture with $\geq 10^3$ colony forming units per millilitre. Acute Respiratory Distress Syndrome (ARDS) was defined as the presence of a $PaO_2/FiO_2 < 200$ mmHg in the presence of bilateral alveolar infiltrates on chest X-ray. Renal failure was defined as the need for dialysis of any duration in patients who did not require dialysis pre-operatively. Urinary retention was defined as the need to reinsert a Foley catheter at any time during the index admission owing to an inability to void and a distended bladder.

Cardiovascular complications

Arrhythmia was defined as any new (not present pre-operatively) cardiac rhythm other than sinus requiring any medical intervention or transfer to a monitored bed. A myocardial infarction (MI) was defined as two or more of the following: chest pain, electrocardiograph changes and/or cardiac enzyme elevation and a fall consistent with MI. A post-operative haemorrhage was defined as a need to return to the operating room or post-operative radiological intervention for haemorrhage, or post-operative gastrointestinal bleeding documented by endoscopy. Deep venous thrombosis (DVT) was defined as a new thrombosis of the superficial femoral, femoral, iliac, brachial, or subclavian veins, internal jugular, or the inferior or superior vena cava. A DVT was diagnosed with extremity ultrasound, computed tomography (CT) or other imaging. A pulmonary embolus (PE) was defined as a new thrombosis of a pulmonary artery and was diagnosed with CT or another imaging modality. Portal or superior mesenteric venous thrombosis was counted as a DVT and was defined as newly diagnosed thrombosis of the PV or SMV documented by any imaging modality such as a CT that was not present before surgery.

Length of stay

Length-of-hospital (LOS) stay was calculated from the day of surgery through and including the day of discharge during the index admission. Return to the intensive care unit (ICU) after discharge to the regular hospital ward was not considered a complication but was used to grade the severity of the reason for return to the ICU (arrhythmia, etc.). Readmission was defined as an admission to any hospital for ≥24 h for any reason within 30 days after surgery. Readmission was not considered as an independent additional complication but was used to grade the severity of the complication that was the reason for readmission. The length of readmission was calculated using the day of readmission to and including the day of discharge.

Data analysis

Outcomes for the two cohorts were recorded in a prospective database and reviewed retrospectively. Groups were compared using a χ^2-/Fisher's exact test for categorical variables, and Wilcoxon's test for continuous variables (median, interquartile range). Data were entered into the Institutional Review Board-approved prospective database in real time by a trained data analyst under the supervision of the surgeon. All data were backed up by source documents and the accuracy of the data entered into the electronic database was periodically reviewed.

Results

Two consecutive cohorts of patients (226 patients total) undergoing pancreatic resection from May 11 2004 to August 14 2010 were compared. In the first cohort (179 patients), drains were routinely placed at the time of surgery and in the second cohort (47 patients) no drains were placed at the time of surgery. The two cohorts were very similar in all respects. Patients who had a pancreaticoduodenectomy or a distal pancreatectomy were included in the present study and there was no difference between the two cohorts in the type of resection. There were also no differences in age, gender, race or ethnicity between the two cohorts (Table 1). There was a higher incidence of hypertension and chronic obstructive pulmonary disease in the group without routine intraperitoneal drainage. There were no clinically significant differences in pre-operative labs between the two cohorts (Table 2). There were no differences between the two cohorts in the size of the pancreatic duct or the texture of the pancreas (Table 3). However, there was some evolution of surgical technique over time from the first (2004 to 2009) to second (2009 to 2010) cohort. The surgeon elected to use an internal pancreatic duct stent for the pancreaticojejunostomy more frequently and there was a decrease in estimated blood loss and transfusions. These changes were not likely related in any way to the use of intraoperative drains but represent changes and perhaps improvement in surgical technique over time. There were no differences between the two cohorts in the indication for resection (Table 4).

Mortality was low in this series and there was no difference between the two groups (Table 5). One patient died of hepatic failure during the index admission and one of urosepsis after discharge. No patients had a prolonged (>30-day) hospital stay so the in-hospital mortality is the same as the 30-day mortality. The frequency and severity of severe complications experienced was

Table 1 Demographics

	Cohort 1 Drain (n = 179)	Cohort 2 No drain (n = 47)	P-value
Age (median, interquartile range)	63 (53–72)	59 (51–70)	0.341***
Gender			0.698**
Male	78 (44%)	19 (40%)	
Race			0.132*
White	162 (90%)	37 (79%)	
Black	12 (6%)	7 (15%)	
Asian	1 (1%)	1 (2%)	
Pacific Islander	2 (1%)	2 (4%)	
Others	2 (1%)	0 (90%)	
Ethnicity			0.749*
Hispanic	12 (7%)	4 (9%)	

*Fisher's exact test, **χ^2-test, ***Wilcoxon's rank sum test.

Table 2 Comorbid conditions and pre-operative labs

	Cohort 1 Drain (n = 179)	Cohort 2 No drain (n = 47)	P-value
Hypertension	46 (26%)	26 (55%)	**0.0001****
Chronic pancreatitis	14 (8%)	6 (13%)	0.384*
Coronary artery disease	18 (10%)	8 (17%)	0.183**
History of myocardial infarction	4 (2%)	2 (4%)	0.607*
Chronic obstructive pulmonary disease	21 (12%)	11 (23%)	**0.041****
Obesity (body mass index >30)	41 (23%)	17 (36%)	0.067**
Tobacco use			0.630**
Current	40 (23%)	8 (18%)	
Ever	63 (36%)	15 (33%)	
Never	73 (41%)	22 (49%)	
ASA			0.698*
1	2 (1%)	1 (2%)	
2	66 (37%)	15 (37%)	
3	99 (55%)	29 (62%)	
4	12 (7%)	2 (4%)	
Albumin (g/dl)	4.1 (3.8–4.4)	4.2 (3.7–4.4)	0.682***
Creatinine (mg/dl)	0.9 (0.8–1.1)	0.9 (0.7–1.1)	0.266***
Total bilirubin (mg/dl)	0.2 (0.1–0.7)	0.6 (0.4–1.0)	**<0.0001*****
Haemoglobin (g/dl)	12.8 (11.4–13.9)	13.5 (12.5–14.7)	**0.012*****

*Fisher's exact test, **χ^2-test, ***Wilcoxon's rank sum test.

not increased by eliminating routine intra-operative drainage. The number of complications experienced per patient was similar in each cohort. The incidence of more severe complications (Grade II or III) was also similar between the two cohorts. Among patients that had a complication, the median complication severity grade was the same in each cohort (2 vs. 2, $P = 0.677$). However, when all patients, those with and those without complications were considered, there was a statistically significant increase in the number of patients who experienced any complication (65% vs. 47%, $P < 0.020$) in the group that had drains and the median complication severity grade was higher in the group that had drains (1 vs. 0, $P < 0.027$).

The spectrum of complications was slightly different in the two cohorts. (Table 5). Of course, elimination of routine intra-operative drains completely eliminated the category of a Grade A post-operative pancreatic fistula because all patients in this cohort

Table 3 Intra-operative data

	Cohort 1 Drain (n = 179)	Cohort 2 No drain (n = 47)	P-value
Procedure			0.524**
Pancreaticoduodenectomy	123 (69%)	30 (64%)	
Distal pancreatectomy	56 (31%)	17 (36%)	
Pancreatic texture (Soft)	87 (56%)	25 (53%)	0.606**
Pancreatic duct (normal, ≤3 mm)	83 (52%)	27 (57%)	0.082**
Pancreatic duct stent	34 (28%)	27 (57%)	**<0.0001****
Operating time (min)	401 (310–490)	400 (314–458)	0.396***
Estimated blood loss (ml)	400 (200–700)	250 (150–500)	**0.006*****
Transfusion	34 (19%)	3 (6%)	**0.038****

*Fisher's exact test, **χ^2-test, ***Wilcoxon's rank sum test.
Note: the pancreatic duct stent is for Whipple only.

Table 4 Pathology

	Cohort 1 Drain (n = 179)	Cohort 2 No Drain (n = 47)	P-value*
Cancer	91 (51%)	22 (47%)	0.202
Cystic Neoplasm	36 (20%)	16 (34%)	
Pancreatitis	30 (17%)	5 (11%)	
Other	22 (12%)	4 (9%)	

*χ^2-test.

who required image-guided percutaneous drainage of intra-abdominal fluid with an elevated amylase concentration were defined as having at least Grade B pancreatic fistulae (not A). However, eliminating intra-operative drains did not change the incidence or severity of clinically significant (Grade B or C) pancreatic fistula (Table 5). Of course all five patients (11%) who developed a pancreatic fistula in the cohort that did not have an operatively placed drain required percutaneous drainage and two of these patients (4%) also met the criteria for an abdominal abscess.

Among the patients without drains placed at the initial operation, none required a return to the operating room for a pancreatic fistula and/or abscess. In the first cohort, three patients (2%) had a pancreatic leak or abscess that was not controlled with the operatively placed drain and required a post-operative percutaneous drain. In addition, eight patients (4%) in the first cohort required reoperation. Among the group without drains placed at the time of pancreas resection none required a return to the operating room. Elimination of a routine intra-operative drain placement also seemed to be associated with a trend towards a decrease in the rate of wound infection (12% vs. 2%, $P = 0.054$).

Elimination of a routine intra-operative drain placement was associated with a statistically significant decrease in the length of hospital stay but the median was 7 days for each cohort. However, there was a significant increase in the readmission rate (9% vs. 17% $P = 0.007$). The five patients who did not have drains placed at the time of resection who developed post-operative pancreatic fistulae were readmitted for percutaneous drain placement and three additional patients were admitted simply for observation. Most patients who required post-operative percutaneous drainage were readmitted about 19 days after their pancreas resection. As experienced is gained, it may be possible to manage some of these patients without hospital readmission. Most of these patients were discharged rapidly after percutaneous drain placement so there was not much difference in length of stay even when the readmission days were added to the index admission.

An additional analysis was performed on the subset of patients that we defined as having a high risk for a pancreatic leak [presence of soft pancreas and/or small (<3 mm) pancreatic duct]. In all, 33% of the patients in the drained cohort, and 47% of the patients in the no drain cohort met these criteria. When considering just this subset, there was no statistically significant difference in the frequency or severity of complications experienced by the two cohorts. The clinically significant (Grade B/C) pancreatic leak rate was 15% vs. 14% (NS).

Discussion

As a result of the high incidence of post-operative pancreatic fistulae and other sometimes related complications such as an intra-abdominal abscess, biliary leak, enteric leak or even haemorrhage, it has been a surgical dogma for decades that drains

Table 5 30-day outcome data

Overall morbidity and mortality	Cohort 1 (*n* = 179)	Cohort 2 (*n* = 47)	*P*-value
30-day mortality	1 (1%)	1 (1%)	0.373*
Severity of complications			
Patients with any complication ≥grade III	38 (21%)	7 (15%)	0.333**
Patients with any complication ≥grade II	52 (29%)	12 (26%)	0.634**
Patients with any complication ≥grade I	117 (65%)	22 (47%)	**0.020****
Median complication severity grade (median, quintiles) for patients with complications	2 (1–4)	2 (1–4)	0.677
Median complication severity grade (median, quintiles) for all patients	1 (0–3)	0 (0–2)	**0.027*****
Number of complications (any grade)			0.351*
Patients with one complication	54 (30%)	13 (28%)	
Patients with two complications	35 (20%)	5 (11%)	
Patients with three complications	19 (11%)	3 (6%)	
Patients with four complications	4 (2%)	1 (2%)	
Patients with five complications	4 (2%)	0 (0%)	
Patients with > five complications	1 (1%)	0 (0%)	
Specific complications	**Cohort 1**	**Cohort 2**	***P*-value**
Pancreatic fistula (No vs. A/B/C)	79 (44%)	5 (11%)	**<0.0001****
Pancreatic fistula (Grade A)	58 (32%)	0 (0%)	**<0.0001***
Pancreatic fistula (Grade B)	17 (10%)	5 (11%)	
Pancreatic fistula (Grade C)	4 (2%)	0 (0%)	
Wound Infection	22 (12%)	1 (2%)	0.054*
Wound Dehiscence	1 (1%)	0 (0%)	1.000*
Intra-abdominal abscess	10 (6%)	2 (4%)	1.000*
Delayed gastric emptying (No vs. A/B/C)	43 (24%)	4 (9%)	**0.020****
Grade A	32 (18%)	4 (9%)	0.143*
Grade B	8 (4%)	0 (0%)	
Grade C	3 (2%)	0 (0%)	
Pneumonia	3 (2%)	0 (0%)	1.000*
Biliary leak	1 (1%)	0 (0%)	1.000*
Encephalopathy	1 (1%)	1 (2%)	0.373*
New arrhythmia	4 (2%)	0 (0%)	0.583*
Myocardial infarction	0 (0%)	1 (2%)	0.208*
Urinary retention	0 (0%)	1 (2%)	0.209*
Urinary tract infection	6 (3%)	1 (2%)	1.000*
Deep venous thrombosis	2 (1%)	2 (4%)	0.192*
Organ failure	1 (1%)	0 (0%)	1.000
Haemorrhage	3 (2%)	0 (0%)	1.000*
Acute respiratory distress syndrome	2 (1%)	0 (0%)	1.000*
Pulmonary embolus	2 (1%)	1 (2%)	0.507*
Fever	41 (23%)	16 (34%)	0.118**
Post-operative procedures	**Cohort 1**	**Cohort 2**	***P*-value**
Post-operative percutaneous drain	4 (2%)	5 (11%)	**0.001***
Re-operation	8 (4%)	0 (0%)	0.210*
Length of stay (index admission)	7 (7–10)	7 (6–8)	**0.004*****
Readmission	17 (9%)	8 (17%)	**0.007***
Total length of stay (index + readmission)	7 (7–11)	7 (6–9)	**0.016*****

*Fisher's exact test, **χ^2-test, ***Wilcoxon's rank sum test.

should be placed at the time of all pancreatic resections. In other operations, the use of drains has steadily decreased as data have been generated to demonstrate a lack of benefit and even potential harm from their use. However, surgeons have been reluctant to eliminate the routine use of intra-peritoneal drains after pancreatic resection.

In this prospective cohort study, 179 consecutive patients who had a pancreatic resection with placement of intra-peritoneal drains were compared with a subsequent cohort of 47 consecutive patients who had a pancreatic resection without drainage. We found no increase in mortality when drains were eliminated and the frequency or severity of severe complications experienced was not increased. Eliminating the practice of routine intra-peritoneal drainage altered the spectrum of complications experienced with a decrease in the incidence of delayed gastric emptying and a trend towards a decrease in wound infection and an increase in the need for readmission and post-operative percutaneous drainage.

We did not conduct a formal cost analysis as part of the present study. The cost of drains themselves is insignificant. However, the increase in the readmission rate and need for subsequent image-guided percutaneous drainage with the elimination of routine intra-operative drainage would be expected to increase the cost of care. It should be noted that the investigators were conservative and took an aggressive approach towards ensuring patient safety in the present study. Patients without operatively placed drains were followed very closely and all complaints were thoroughly investigated. As experience and confidence is gained with pancreatic resection without drainage, the need for post-operative interventions such as imaging and readmission may be decreased.

Experience in other areas of surgery where drains have been proven to be unnecessary or even harmful makes elimination of routine drainage after a pancreatic resection seem logical However, the fear of devastating complications secondary to a pancreatic leak without drainage keeps most surgeons from abandoning the practice of routine drainage after a pancreatic resection. Some surgeons have adopted a practice of early drain removal hoping to eliminate the potential harm of drains but still enjoy the security of an 'early warning system' for anastomotic complications. Bassi examined this question in patients deemed to have a low risk of a pancreatic fistula (drain fluid amylase concentration ≤5000 U/l on POD 1).[4] A total of 114 eligible patients were randomized to early (POD 3) or late drain removal. Early drain removal was associated with a decreased rate of a pancreatic fistula and abdominal complications. The authors concluded that, in patients at low risk of a pancreatic fistula, intra-abdominal drains can be safely removed early and this may decrease complications.

However, there are numerous problems with this approach. The ideal time to remove the drain is controversial. Many surgeons assume that increased drainage with high amylase content in the first few days after surgery signals a developing clinically significant post-operative pancreatic fistula. Our group reported a series of 177 pancreatic resections in which the drain output and amylase concentration was recorded daily until the drains were removed.[6] We found that this drain data on any particular POD was not sensitive or specific enough to be used as an accurate clinical predictor of subsequent post-operative pancreatic fistula. Some clinically significant leaks may begin late in the post-operative course and this would be after early drain removal.

Without the highest level of evidence it will be difficult to change the opinion of most pancreatic surgeons regarding the routine use of intra-abdominal drains after a pancreatic resection. Some surgeons may be more apt to adopt this approach in patients with chronic pancreatitis who have a dilated pancreatic duct and hard pancreatic parenchyma but more reluctant to abandon routine drainage when the pancreas is soft and the pancreatic duct is small. The present study included both a pancreaticoduodenectomy and a distal pancreatectomy and a diverse mixture of patients with pancreatic tumours, cystic lesions and chronic pancreatitis. Among the subset of patients who had a pancreatic texture that was deemed soft (normal) and a small pancreatic duct (<3 mm) there was no statistically significant difference in any outcome measure. The present data suggest that it may be safe to eliminate routine drainage even in this subset of patients; however, a randomized prospective trial is required to definitively test this hypothesis.

Data in the literature on pancreatic resection without drainage are currently limited. Jeekel provided a retrospective case series of 22 patients who underwent a pancreaticoduodenectomy without drainage.[11] Three patients developed an intra-abdominal abscess and all were managed with percutaneous postoperative drainage. Heslin retrospectively reviewed a series of 89 patients, 51 (57%) with and 38 (43%) without routine intra-peritoneal drainage.[12] There was no statistical difference in the rate or type of complications or LOS between patients who had a drain placed and those who did not. Perhaps the best level of evidence available is from a single-institution randomized prospective trial in which 179 patients undergoing either a pancreaticoduodenectomy or a distal pancreatectomy for pancreatic tumours were randomized to routine intra-abdominal drainage (89 patients) or no drains (90 patients).[10] There was no significant difference in the number or type of complications between the two groups and the authors concluded that closed-suction drainage should not be considered mandatory after pancreatic resection.

The present study adds to the existing small body of literature suggesting that routine intra-peritoneal drainage after a pancreatic resection may not be necessary. Careful analysis of the two cohorts revealed that they were very similar in terms of demographic, surgical and pathological details that may affect the incidence and severity of complications. However, one potential weakness of the present cohort study is that the clinical practice of surgery evolved during enrolment. There is a possibility that any changes over time such as decreased blood loss and transfusion rate and overall efforts to decrease LOS could have confounded the outcomes. However, the evidence provided by the present study, and other data in the literature, suggests that it would be ethical and desirable to conduct a larger multicentre randomized prospective trial to definitively evaluate the outcome of a pancreatic resection with and without routine intra-peritoneal drainage.

Conclusion

Abandoning the practice of routine intraperitoneal drainage after a pancreatic resection may not increase the overall incidence or severity of severe post-operative complications but the spectrum of complications may be altered. The benefits derived by patients who avoid drains may be offset by a subset of patients who require readmission and post-operative percutaneous drainage.

Conflicts of interest

Nothing to disclose.

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